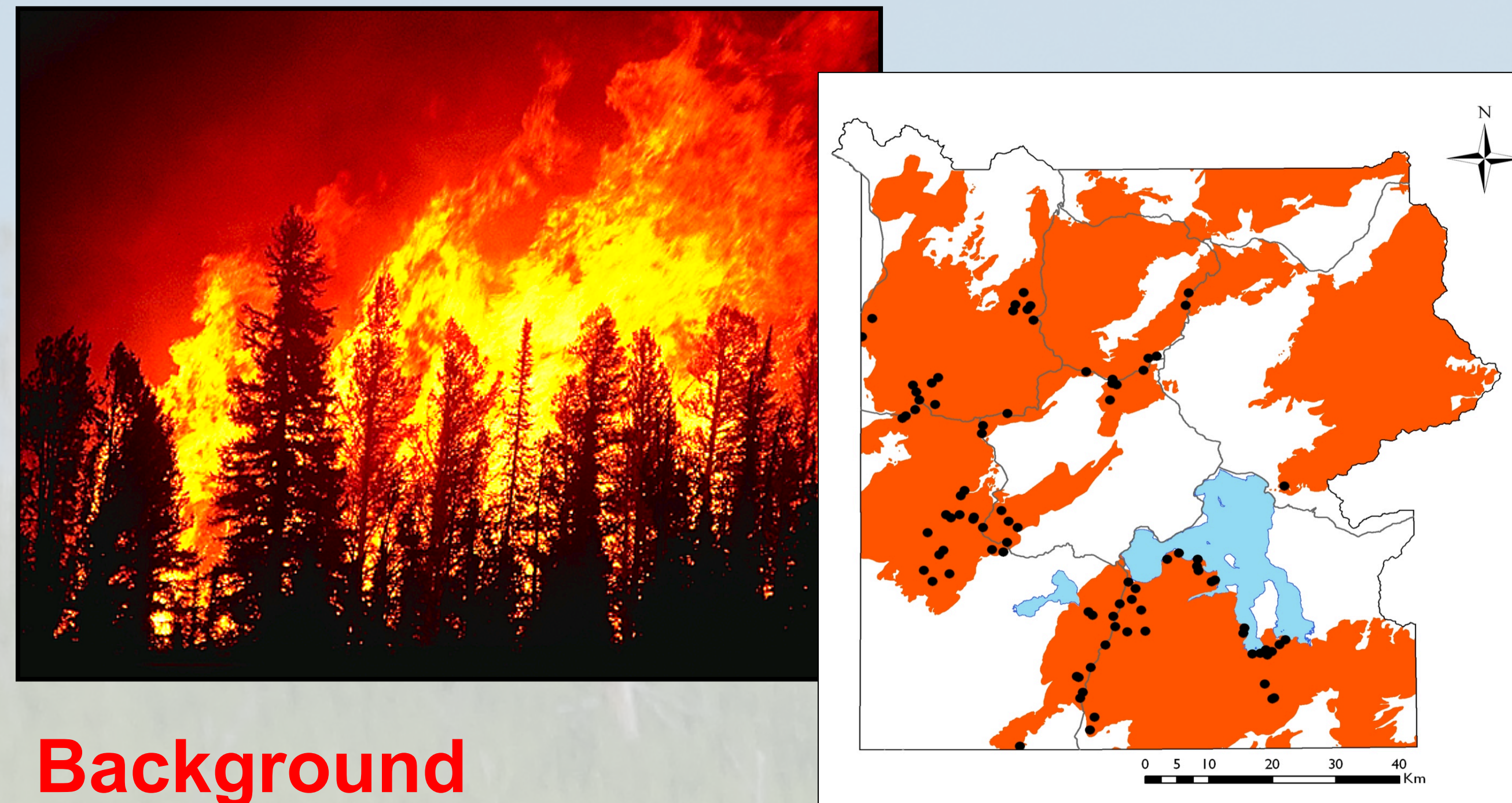


# Landscape patterns of early postfire lodgepole pine regeneration dominate stand structure and function 24 years after the 1988 Yellowstone Fires

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## Background

- Understanding the rate and spatial variability of postfire succession in western US forests is important.
  - Increasing fire → more young, postfire forests
  - Few studies have tracked landscape patterns of succession following large, stand-replacing fires
- The 1988 Yellowstone Fires affected > 300,000 ha of forest, creating a complex postfire mosaic (Romme et al. 2011).
  - Striking landscape variation in Initial postfire lodgepole pine (*Pinus contorta*) regeneration, ranging from 0 to > 500,000 ha<sup>-1</sup> in response to prefire serotiny and fire severity (Turner 2010)

## Question and hypotheses

- Are stand structure and function beginning to converge 24 years after the 1988 Fires?**

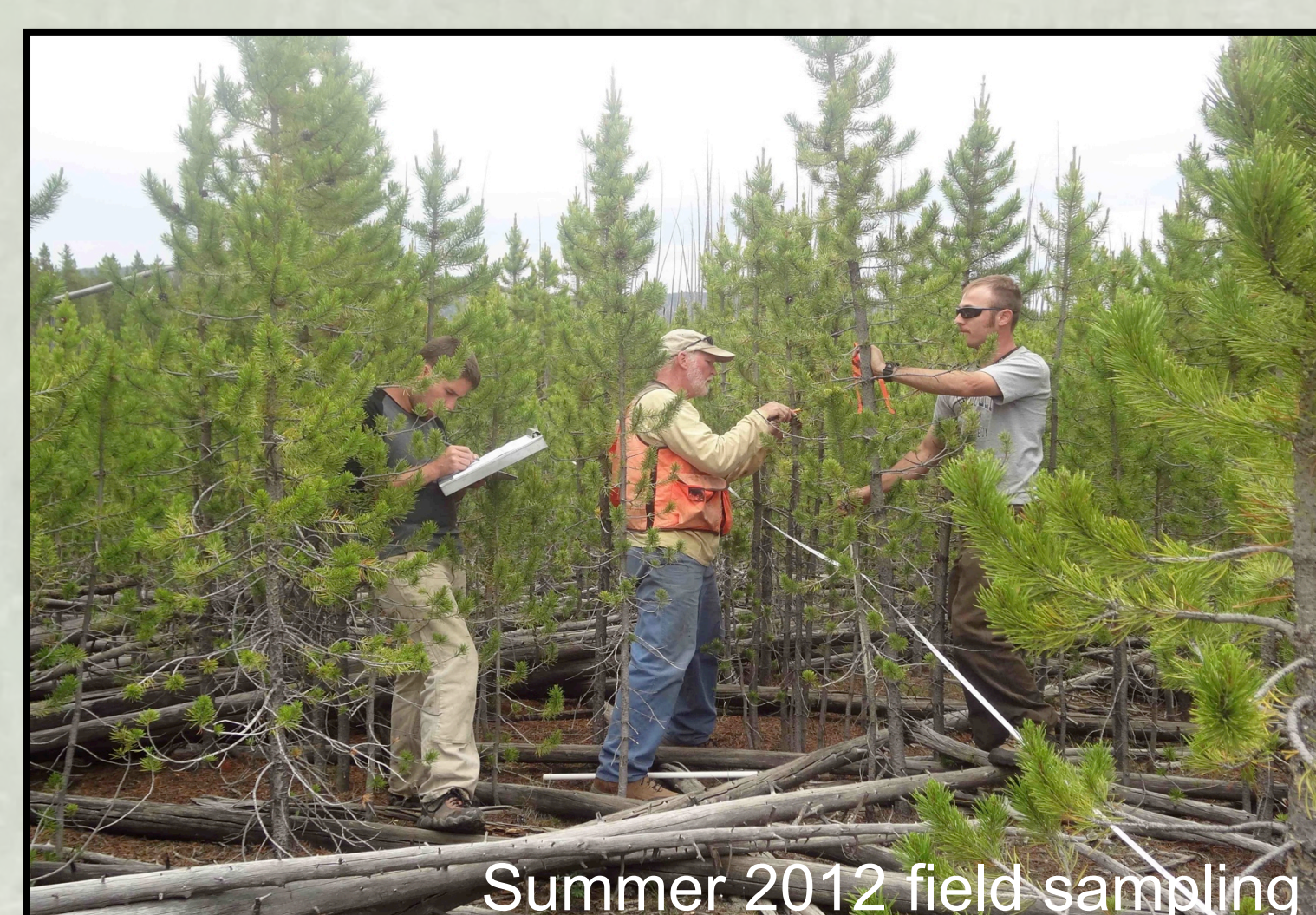
**H1:** Landscape variation in postfire tree density and basal area have declined due to density-dependent mortality.

**H2:** Landscape variation in aboveground net primary production (ANPP) has decreased due to decreasing ANPP in high-density stands and increasing ANPP in low- to moderate-density stands.

- Postfire tree density remains a “master variable” that determines stand-level ecosystem function.

## Methods

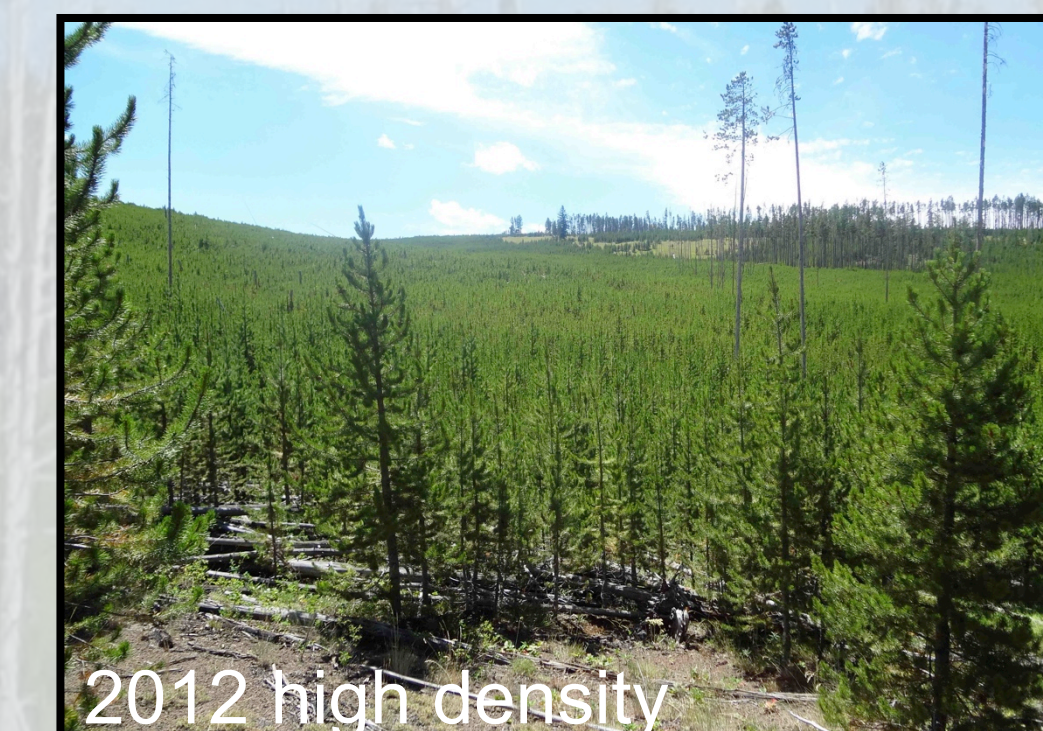
- In 2012, we re-sampled 72 widely distributed 0.25-ha plots in postfire lodgepole pine last sampled in 1999 (11 years postfire), using the same protocols (Turner et al. 2004).



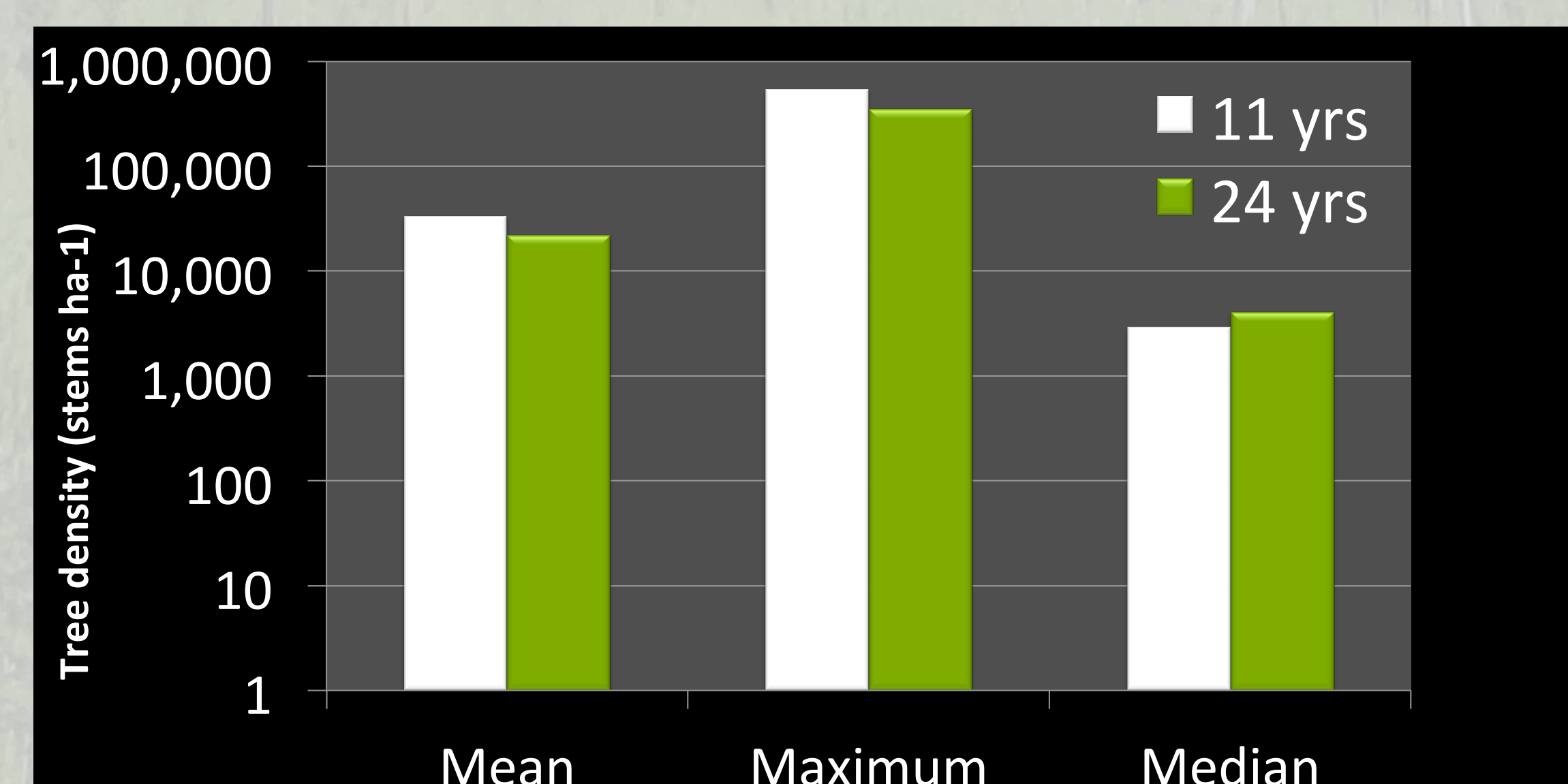
## Results

### H1 Stand structure: Tree density

- Landscape variation in postfire lodgepole pine density has changed little thus far.
  - Similar CV at 11 (285%) and 24 yrs (250%) postfire



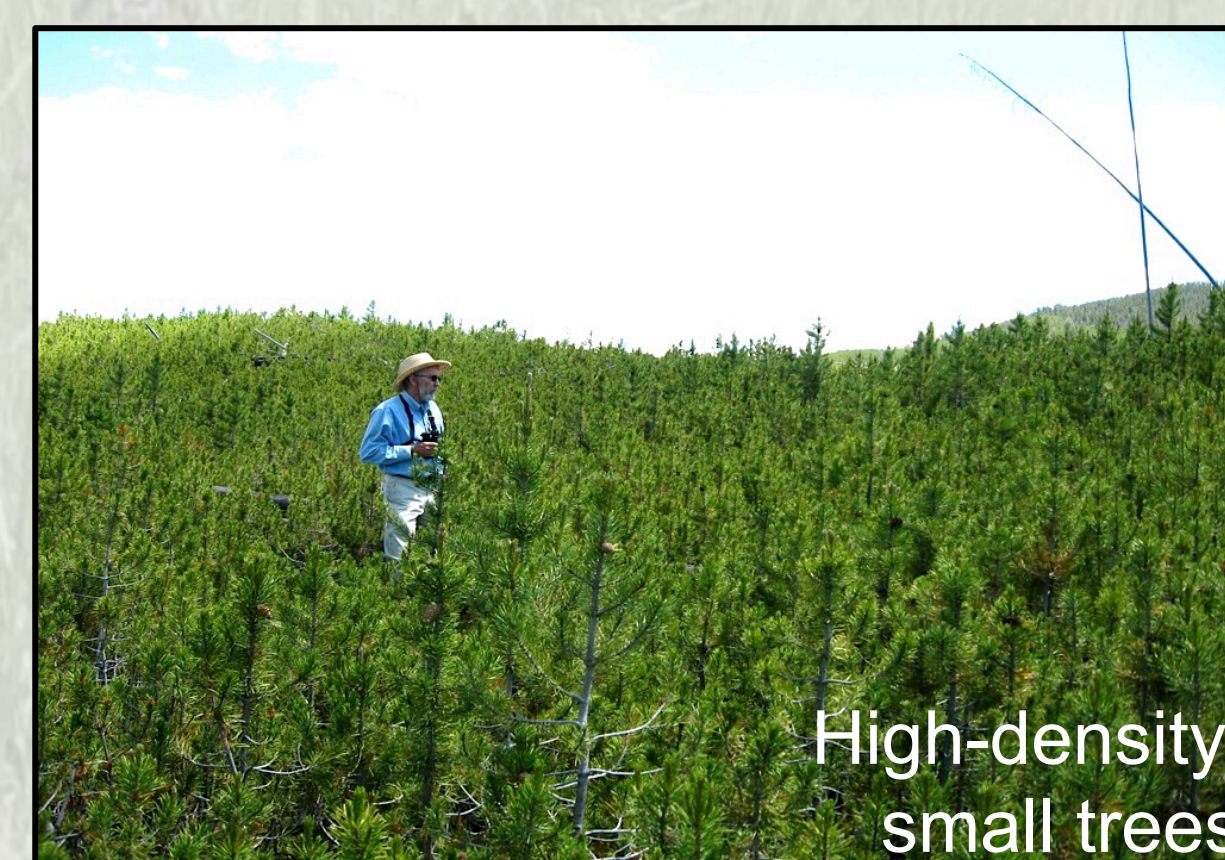
- Lodgepole pine density changed relatively little from 11 to 24 yrs postfire and remained very high.



- Mean of 21,738 ha<sup>-1</sup> (range 0 to 344,000) at 24 yrs postfire
  - Decline in mean (from 32,000 ha<sup>-1</sup> at 11 yrs postfire) driven by very large declines (>100,000 ha<sup>-1</sup>) in three highest-density stands
- Median increased by 233 ha<sup>-1</sup> since 11 yrs postfire
  - Tree density increased in 60% of the plots
  - Greater increase in low-density stands, but even stands with density >10,000 ha<sup>-1</sup> increased
- Lodgepole pine density at 24 yrs highly correlated with density at 11 yrs postfire ( $R = 0.90$   $P < 0.0001$ )

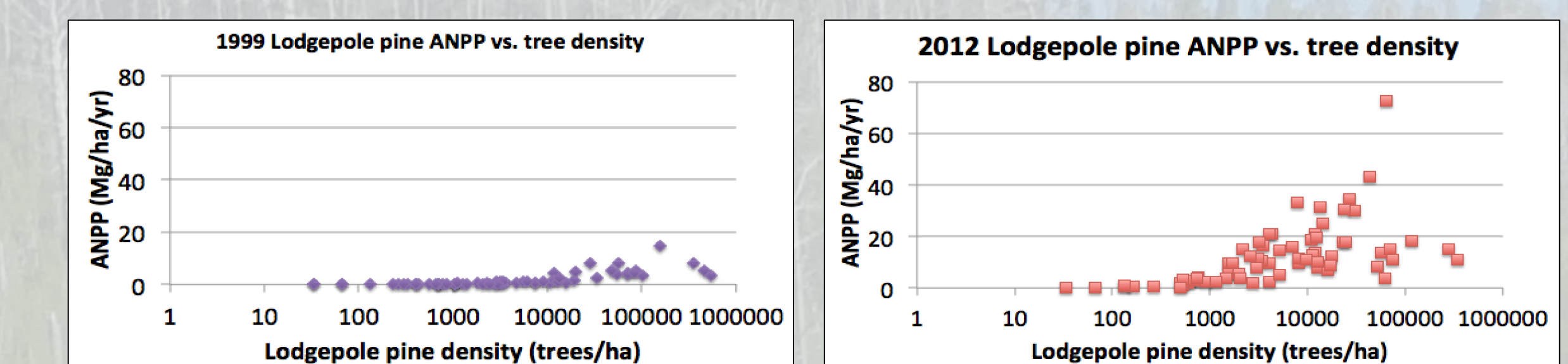
### H1 Stand structure: Basal area

- Landscape variation in lodgepole pine basal area also remained very high at 24 yrs postfire.
  - Mean of 25.3 m<sup>2</sup> ha<sup>-1</sup> (range 0 to 146), increasing with stand density ( $R = 0.87$ ,  $P < 0.0001$ )
  - Dense stands have smaller trees ( $R = -0.71$ ,  $P < 0.0001$ )

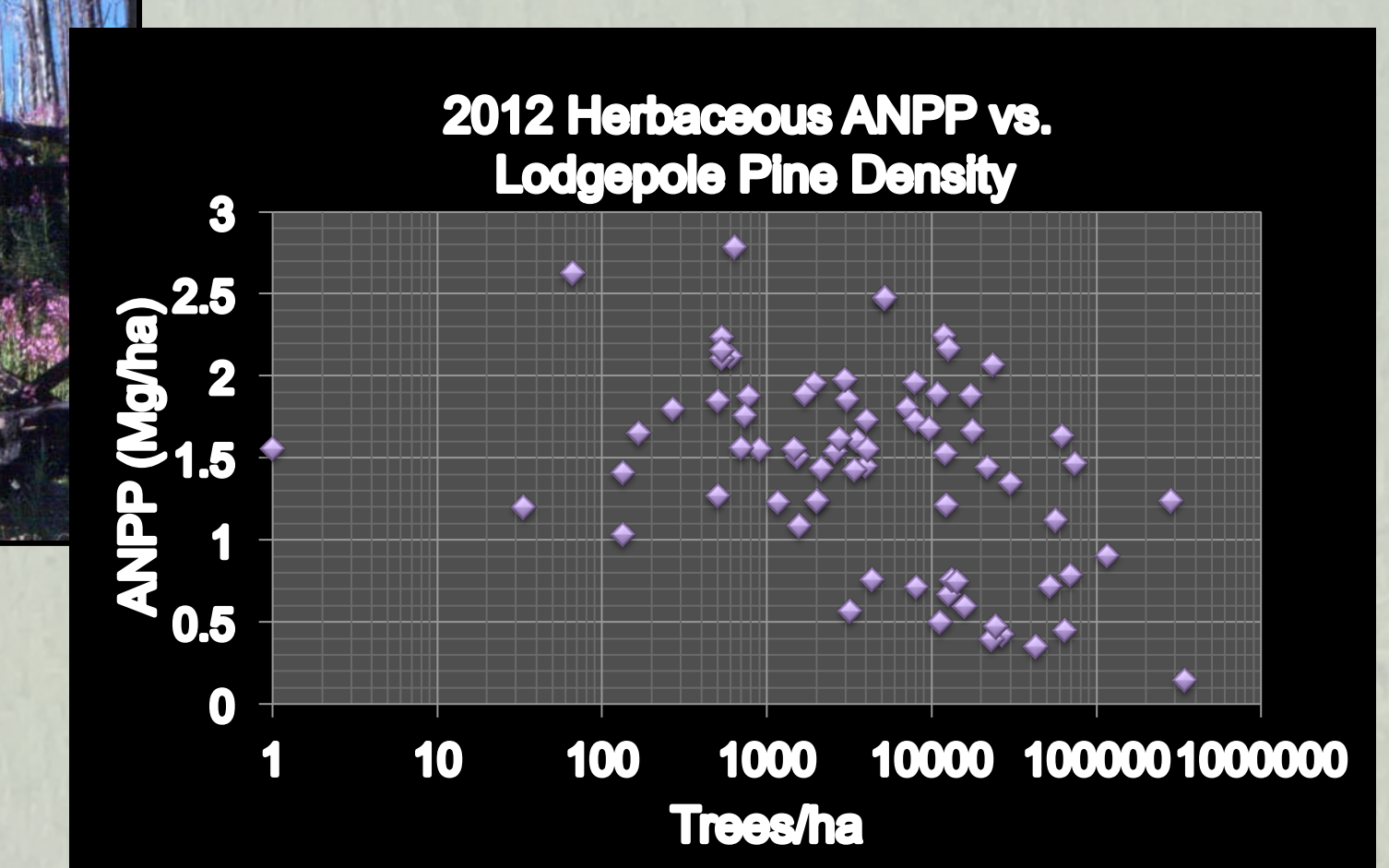


### H2 Stand function: ANPP

- Landscape variation in ANPP declined between 11 yrs (CV 156%) and 24 yrs (CV 106%) postfire.
- Mean lodgepole pine ANPP increased ~10x between 11 and 24 yrs postfire (from 1.72 to 11.92 Mg ha<sup>-1</sup> yr<sup>-1</sup>).
  - ANPP increased in all stands with trees
  - ANPP increased with tree density ( $R = 0.76$ ,  $P < 0.0001$ )

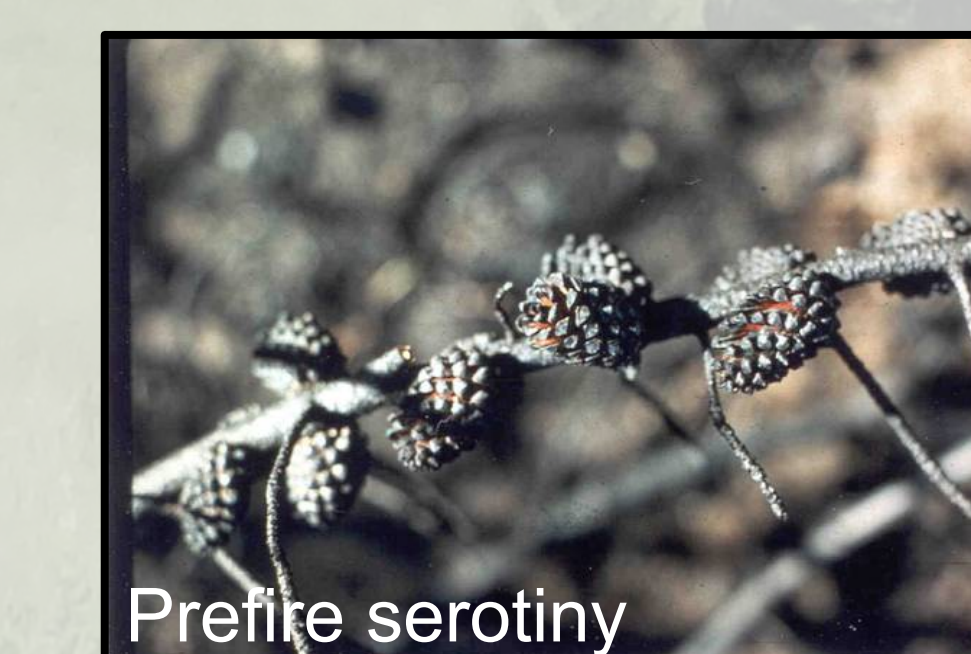


- Mean herbaceous ANPP increased ~40% between 11 and 24 yrs postfire (from 1.05 to 1.44 Mg ha<sup>-1</sup> yr<sup>-1</sup>).
  - Herbaceous ANPP declined with tree density



## Conclusions

- Stand structure is not yet converging, but ANPP is increasing rapidly and shows signs of converging.
- Initial landscape pattern of postfire tree density still dominates stand trajectories 25 yrs after the '88 fires.
  - Contingent factors → persistent landscape legacy



## Literature cited

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## Acknowledgements

- Thanks to Kellen Nelson, Paige Copenhaver, Dan Donato, Natalie Kaner, Andy Muench and Winslow Hansen for field assistance during summer 2012.
- Research funded by the Joint Fire Science Program

